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ADVANCED PROCESS OF PRODUCTION OF LONG-LENGTH TUBE PARTS FROM ELECTROCERAMICS

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A mechanized continuous line for the production of long-length hollow tube electroceramic parts is described. The line consists of an automated complex for shaping and drying the tubes, a glazing block, a roasting module, and a cutting lathe. The line makes it possible to automate the laborious operations of shaping, drying, glazing, and roasting.

The high requirements on geometrical parameters and the quality of the surface of electroceramic parts that serve under the action of electrical and mechanical loads, aggressive media, and thermal shocks stimulate advances in the design of parts and the process of their production. The main direction in improving quality consists in automation and mechanization of the production.

Long-length cylindric parts, for example tubes 2000 mm long and up to 100 mm in diameter, are shaped by the method of extrusion (drawing) [1] from a plastic mixture, and the operations of their production process are quite laborious and inconvenient, i.e., shaping, drying, glazing, and roasting.

In this connection, we attempted to develop a technology for the production of hollow cylindrical (tube) insulators and the corresponding equipment that would provide a high output starting with the operation of charging the vacuum press and ending with the roasting.

We have developed such a technology, which includes preparation of an electroporcelain mixture with a moisture content of 18 – 19% and a glaze suspension with a moisture content of 55 – 60%, pressing-in and evacuation of the mixture, drawing of preforms and their cutting, drying with simultaneous rolling of the preforms in order to prevent their deformation, glazing by the method of rolling except for the process of paraffin treatment of the places not to be glazed, and roasting of vertically positioned preforms.

In correspondence with the developed technology the Slavyansk Institute of Ceramic Machine Building has designed and produced a mechanized continuous line for manufacturing electroinsulating tubes PK-6/75 and PK-10/50 (Fig. 1*a*) used for electric fuses designed for 6 and 10 kV. Figure 1*b* depicts a similar tube with engraved ring grooves having width *e* and positioned at the places of fastening of the metallic fixtures.

The technical characteristic of the tubes is presented in Table 1 and the compositions of the porcelain mixture and the glaze suspension are presented in Table 2.

Properties of the Mixture

Remainder on screen No. 0056 (10,000 holes/cm^2), %	2.5
Molding moisture content, %	18 – 19
Roasting temperature (maximum), °C	1320
Shrinkage, %	
air	4.2
fire	10.0
Porosity, %	0

Technical Characteristic of the Line

Output, pieces/h	100
Moisture content of porcelain mixture, %	18 – 19

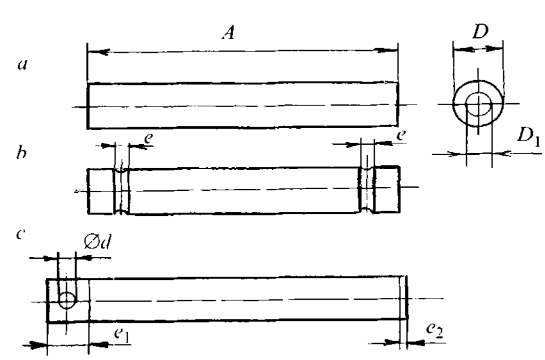

Fig. 1. Electroinsulating tubes: *a*) cylindrical; *b*) cylindrical with ring grooves; *c*) preform.

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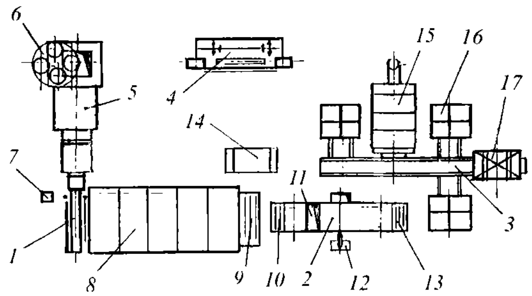

Fig. 2. Mechanized continuous line for fabricating tube electroceramics.

Rarefaction in the vacuum chamber of the vacuum press, Pa	99×10^3
Drying temperature (maximum), °C	300
Density of glaze, g/cm^3	1.45
Number of turns of the tube in glaze	3
Roasting temperature (maximum), °C	1320
Number of operator positions at the line	7

The block and module design of the line (Fig. 2) makes it possible to single out an automated unit for shaping and drying the tubes *1*, a glazing block *2*, a roasting module *3*, and a cutting lath *4*.

Automated unit *1* consists of a vacuum press *5* equipped with a feeder *6*, a device *7* for cutting the preform and piercing holes with diameter d (Fig. 1*c*), and a conveyer drier *8* with accumulator *9* of the dried tubes. The feeder is the main part of the unit, which provides automatic matching of the process of drawing of preforms to their placement on the conveyer of the drier. The feeder has the form of a cassette rotating in a horizontal plane at a constant speed, in which four preforms from a degassed plastic mixture are mounted vertically. The cassette is mounted on a mobile platform with a knife positioned under the charging window of the vacuum press. The charging of the latter is performed in correspondence with the amount of the mixture leaving the nozzle of the vacuum press and controlled continuously by the speed of rotation of the cassette and the angle at which the knife is positioned.

A drier is a horizontal chain conveyer having rotating rollers receiving tubular preforms (see Fig. 1*c*) manufactured with machining allowance e_1 and e_2. Rotation of the tubular preforms on the rollers makes it possible to improve drying conditions and ensure the desired configuration of dried semiproducts. The speed of motion of the conveyer chain is controlled continuously in the range 0.03 – 1.0 m/min, and the rotation frequency of the preforms on the rolls of the drier is 0.6 – 30 min^{-1}. The drier is heated with the help of nichrome heaters. The conveyer is covered by a metallic casing having an appropriate heat-insulating protection and ventilation system.

Glazing block *2* switches feeder *10* that serves for receiving the dried tubes and their piece-by-piece transfer for glazing and a glazing machine [2] in the form of a walking-beam conveyer with working positions *11* and *12* for glazing the external and internal surfaces of the tubes respectively. Accumulator *13* serves for receiving, accumulating, and transporting the glazed tubes to the place of removal. It should be noted that each working position is formed by two pairs of supporting rollers that can rotate around their horizontal axes. One axis has a spring-bearing tubular ogee that can perform a reciprocating motion and is connected with the pipeline for feeding glaze, and the other axis is equipped with a trough for feeding glaze to the external surface of the tube, which is positioned between the supporting rollers; the pipelines for feeding glaze to the ogee and the trough are equipped with valves for regulating the flow. One pair of the supporting rolls placed on the side of the ogee for glazing the internal surface of the tube is positioned higher than the second pair in order to provide a slope; in order to provide rotation of the glazed tube, one pair of the rolls is connected with the drive.

The regions of the surface of the tube on which the metallic fixtures are fastened with the help of a sand-cement binder are not subjected to glazing. These regions can be on the ends of the tube, in the middle, or in any other place. The dried tubes that should not be glazed are transferred from the accumulator of the conveyer drier into shelf containers *14*; the latter are transferred, for example, with the help of an overhead-track hoist, into the roasting module to the place of mounting into the furnace cars. It should be noted that before the described line has been installed the regions of the tube not to be glazed were preliminarily covered by molten paraffin, which complicated the process and made the tubes more expensive.

Roasting module *3* consists of a chamber gas furnace *15*, furnace cars *16*, and transporting carriage *17*. The roasting of such unglazed tubes can be performed in a horizontal posi-

TABLE 1

Type of tube	Voltage, kV			Sizes, mm			Mass, kg
	rated	actual	break-down	A	D	D_1	
PK-6/75	6	36	58	354	61	48	0.9
PK-10/50	10	47	75	454	61	48	1.1

TABLE 2

Component	Content, %	
	in porcelain mixture	in glaze suspension
Pegmatite	22 – 24	22 – 24
Quartz sand	21 – 23	32 – 34
Porcelain scrap	5 – 12	21 – 23
Clay	25 – 27	2 – 3
Kaolinite	20 – 22	7 – 8
Dolomite	–	–

tion. In this case they are placed on the furnace car under which alumina is preliminarily poured in a layer of 20 mm. The tubes are arranged in 4 – 6 rows over the height. Glazed short tubes are roasted only vertically on rods fastened in a vertical position or horizontally in T-shaped slots made in the roof of the furnace or in the lining of the furnace car stack. The heat of the flue gases is used for heating the air fed for combustion of the fuel (natural gas) in the recuperative device.

The mechanical treatment of the tubes is performed in a cutting lathe *4* where the allowances e_1 and e_2 are cut off and the ring grooves e are made if necessary. The tubes are mounted and removed manually. The ready tubes are placed into shelf containers and transported for packing, where every tube is wrapped with foam rubber and placed in a cardboard box. The boxes are placed in a compartment and delivered to the consumer or to the store.

Long-length tube electroceramics are produced in the mechanized continuous line by the conventional scheme that includes loading of the vacuum press → drawing of preforms → cutting and simultaneous piercing of technological holes → placement on the drier conveyer → drying → glazing (if necessary) → roasting → mechanical treatment → packing. The laborious process stages of shaping, drying, and glazing of the tubes are fully automated.

The installation of the new line allowed the Slavyansk plant of high-voltage insulators to advance the technology of tube and rod parts from electroceramics, widen the range of products, improve the technical and economical parameters, raise the output of quality parts, and decrease their cost.

REFERENCES

1. N. V. Nikulin and V. V. Kortnev, *Production of Electroceramic Parts* [in Russian], Vysshaya Shkola, Moscow (1970).
2. B. I. Gaidash, V. A. Aleko, and V. I. Smelov, "Automated conveyer line for glazing insulator tubes," *Steklo Keram.*, No. 11, 19 – 20 (1989).